APPENDIX A - PRESTRESSING SYSTEMS

I - NEW SYSTEMS

The following checklist includes the minimum required information necessary for approval by the Transportation Laboratory of a new or modified post-tensioning system:

All prestressing systems that are proposed to be used in the State of California shall be submitted in the following form to expedite approval of the system or systems.

Seven copies of the final submittal are required by Caltrans and shall be bound or stapled together with a title page indicating the name or names of the systems being submitted. The individual numbered sections shall be tabbed and listed in the following order:

1. DESCRIPTION
   a. Current product description literature of the system or systems being proposed.
   b. Prior listing of the system. Include specific details of projects where it has been used.
   c. Complete records of tests run on the system independent of Caltrans' witness tests.
   d. Explain how seating loss is to be controlled and measured.

2. HARDWARE

   a. Anchor head.

      1) Detailed drawing.

      2) Mill certificates - showing material composition, strength and manufacturer.

      3) Quality control document

   b. Bearing Plate

      1) Detailed drawing.

      2) Mill certificate.

      3) Quality control statement.

   c. Wedges or Nuts

      1) Detailed drawing.

      2) Mill certificate,

      3) Quality control document.

   d. Trumpet detail drawings.

3. CALCULATIONS

   a. Stress behind bearing plate at service load after losses.

   b. Stress behind bearing plate at 95% specified ultimate tensile strength.

   c. Maximum bending stress in bearing plate of 95% specified ultimate tensile strength.

4. SYSTEM

   a. Detailed drawings of the anchorage system, jacking system, duct and grouting details.

b. Complete information on grouting procedures and equipment to be used,

c. Description of how system components are protected from physical damage and corrosion.

d. Description of tendon repair or replacement should a failure occur,

e. Description of how qualified technical assistance is provided in the field for the Contractor performing the work.

II. - PRESENTLY USED SYSTEMS

Following is a summary of the State approved prestress systems. The summary is considered complete and includes both systems used in bridges and as tieback anchors. However, it should be remembered that new developments in the prestress industry necessitate change. Therefore, the various systems may revise capacities, improve anchorages, develop new jacks, etc. Of course, changes such as these may void prior system approval. Many of the companies also have system capabilities (smaller and larger) which have not been approved for State use. Both the Sacramento HQ TRANS LAB and the Division of Structures Prestress Committee have current files for all approved systems. Check the Structure Construction Bulletin Board for a current list of those contractors with currently approved systems.

AVAR Construction Systems. Inc.

The AVAR System utilizes 0.5" strand anchored with split wedges at both the anchor plate and the pulling head. AVAR presently uses anchorage systems utilizing 3, 4, 5, 7, 12, 22, and 34 stands maximum. Note Load Cell between stressing head and center hole ram.

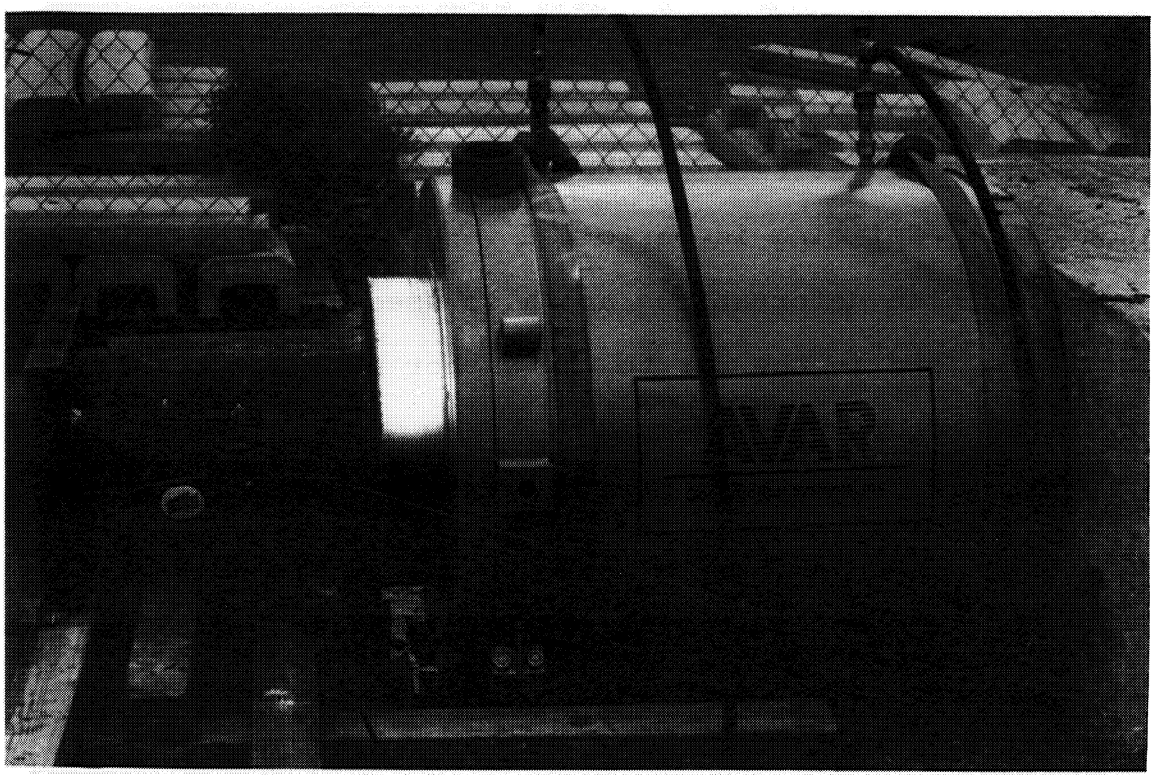

PHOTO 10
PHOTO BY AVAR CONSTRUCTION SYSTEMS INC.

Dywidag - DSI (Dyckerhoff and Widmann, Inc.)

Dywidag systems include both deformed bar and strand systems. The Dywidag threaded bar prestressing system was developed in Europe. It's use, including a broad application as a rock anchor, has greatly expanded in this country since its introduction a decade ago. The bars have cold-rolled, thread-type deformations continuous along two opposite sides of the bar. The continuous deformations are especially adaptable to segmental construction. The bars can be cut to any length to fit field conditions and yet retain a threaded end for splicing or anchoring. Splicing is performed very simply with threaded couplers. The deformations are also used to transfer the prestress load in the bar to the anchor nut, and to bond the bar to the structure when grouted.

The bars are available in various diameter sizes. They may be used as a single tendon (monobar) or in multiple groups. State approved applications use l", l-1/4" or 1-3/8" monobar. A bell-type anchorage is normally used with the monobar. The bell consists of a steel cylindrical section with a thin steel plate attached to one end. The principle behind the design of the anchor is to confine concrete within the cylinder and let the confined concrete transmit the majority of the anchor load to the structure.

Stress is applied with small, portable jacks which can be handled by one or two persons. The jacks contain a ratchet assembly which is used to advance the hex anchor nut when stressing the bar. The smaller size jack, although rates at 60 metric ton, has the capacity to stress the l-1/4" bar to 75% ultimate. The larger jack, rated at 110 metric tons, is more rugged and is used for difficult conditions. (Metric ton equals 2204 lbs.)

Dywidag strand systems typically use 0.6" strand for 4 strand to 27 strand tendons. A 31 strand tendon is also approved using 0.5" strand.

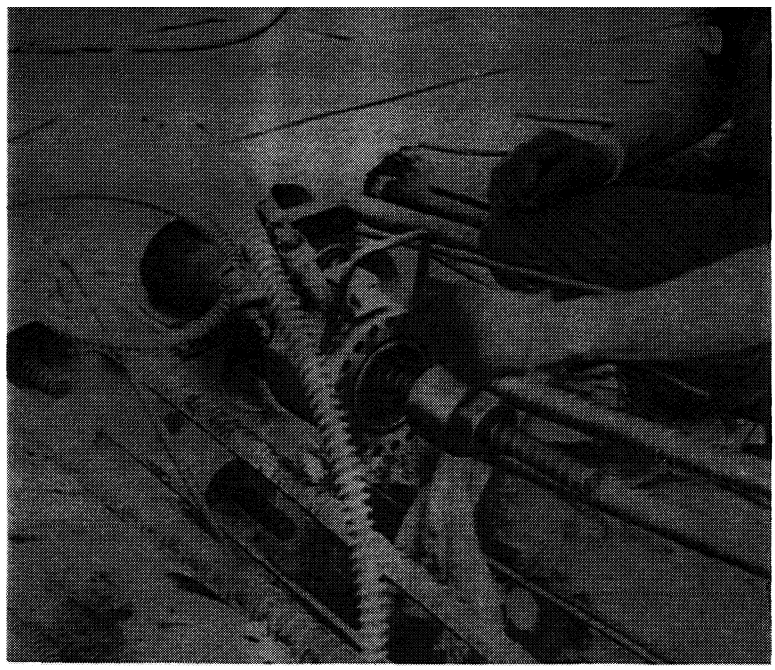

PHOTO 11
DYWIDAG'S 60 - TON MONOBAR JACK

PHOTO 12
MONOBAR ANCHORAGE

APPENDIX A - PRESTRESSING SYSTEMS

Stresstek System

Stresstek is not currently (9/91) active on State projects, but is an approved system. Stresstek anchors individual l/2" strands with a pair of split wedges at the anchor plate and three piece wedges in the pulling head. Individual strands are placed in a strand guide which is inserted into the center hole of the jack. A manually operated device, either mechanical or hydraulic, is used to initiate seating of the permanent wedges.

Anchorage systems presently used are capable of holding a maximum of 13, 19, or 31 strands, Also approved are the Stresstek 0.6" strand systems using 4, 7, 13, or 19 strands maximum.

PHOTO 13
19 STRAND STRESSTEK JACK
(Photo by Stresstek)

VSL System

The VSL System uses individual l/2" strands anchored with pairs of split wedges at the anchor plate and three part wedges at the pulling head. VSL presently uses anchorage systems capable of holding a maximum of 1, 4, 7, 12, 19 24, 27, and 31 strands, The anchor set is determined by the head space between the anchor plate and jack. A 4 strand system utilizing 0.6" strand has also been approved for use on State projects.

PHOTO 14
31 STRAND VSL JACK

VSL has also developed a flat duct system which makes use of 4 parallel 0.5" strands all in one plane. The duct is longitudinally seamed, 2" round galvanized drain pipe that has been flattened to a 2-3/4" x 7/8" section. A special cast steel anchorage unit splays the strands to a 5" width and seats conventional VSL wedges. A highly portable lightweight (60#) monostrand jack is used for stressing.

A short plastic tapered section transitions the flat duct to the flat steel anchorage. A steel tension ring is inserted at the smaller end to confine the lateral forces caused by the splayed ends,

This system is especially useful for stressing thin slabs transversely.

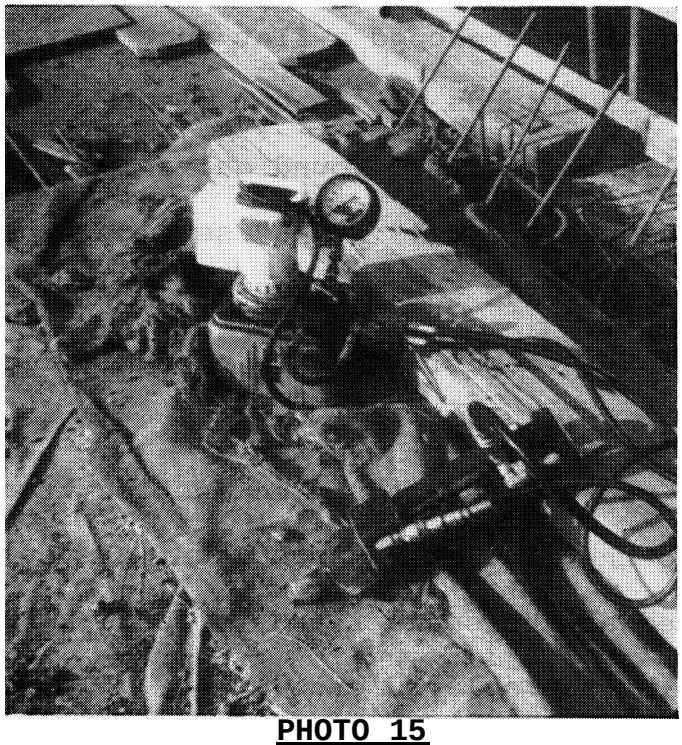

PHOTO 15
VSL MONOSTRAND JACK

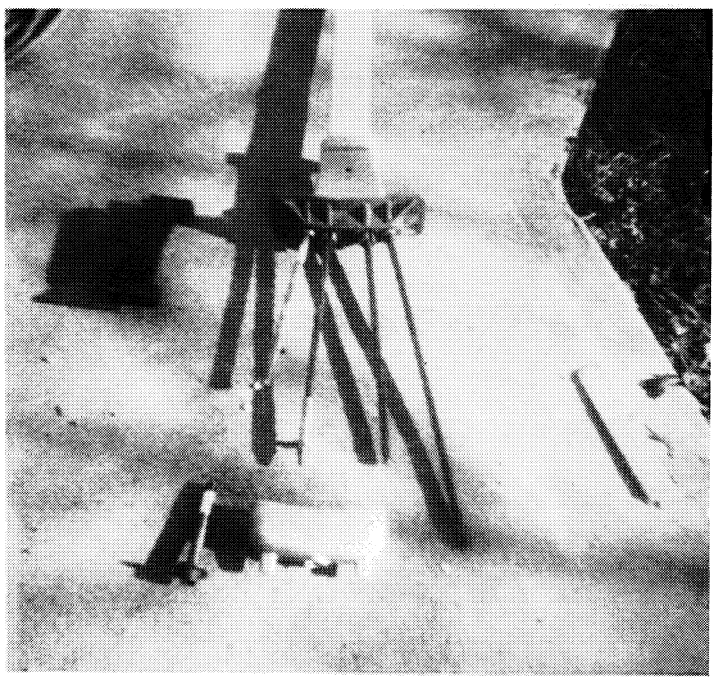

PHOTO 16
VSL FLAT DUCT ANCHOR

Western Concrete Structures System

Western Concrete Structures, Inc. is not currently active on State projects, but is an approved system, The Western Concrete System anchors individual l/2"' strands with pairs of split wedges at both the anchor plate and jack pulling head. Western uses a center hole jack with a strand guide permanently fixed in the center hole. A power seat is not available in this system to seat the wedges.

Anchorage systems presently approved are capable of holding a maximum of 1, 4, 12, 16, 20, 24, 28, and 48 strands.

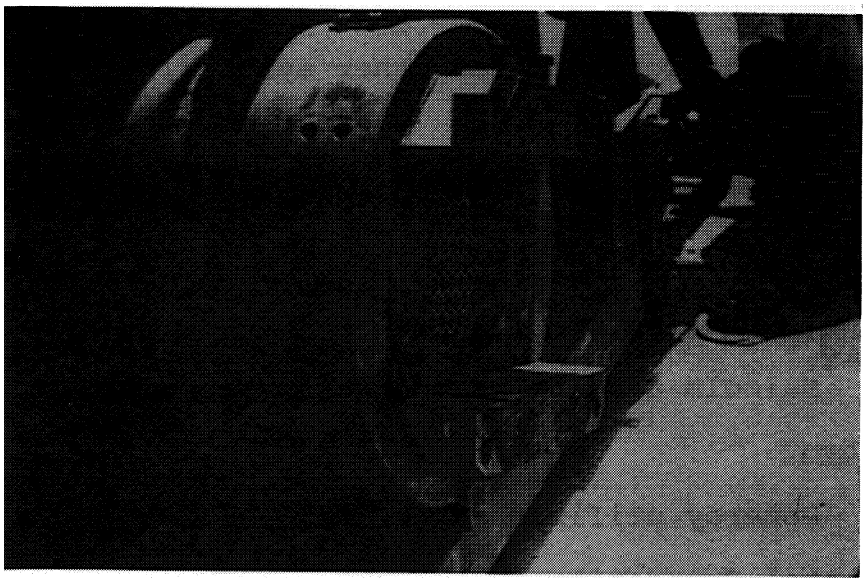

PHOTO 17
WESTERN'S 48 STRAND JACK

III. Soil Anchors

The use of soil anchors as tiebacks, tiedowns, and soil nails for both temporary and permanent work has become increasingly common. Section 9 of the Trenching and Shoring Manual contains information on the design and analysis of these systems for temporary work. Specifications for installation and testing of permanent anchors are contained in the contract Special Provisions.

The following approved post tensioning Contractors perform tensioning on soil anchors only:

Case-Pacific

Case-Pacific utilized other approved systems,

Foundation Constructors

Foundation utilizes other systems.

Mahaffey Drilling

Mahaffey also utilizes other systems previously discussed.

Malcolm, Drilling Co., Inc.

Malcolm also utilized other systems.

Pomeroy

Pomeroy utilizes other approved systems

Schnabel Foundation

Although not currently on the Translab active list, Schnabel is an approved Contractor, They utilize the LANG

system which is approved for 0.6" strand with an anchorage capable of a maximum of 6 strands,

Wagner Construction

Wagner also utilizes other approved systems.

IV. STRENGTHENING

Strengthening of bridge structures provides another use for post-tensioning systems. This work usually consists of pairs of single strand tendons, one on each side of the girder to be strengthened. These tendons are then tensioned simultaneously and later grouted. As with all previously, described prestressing, only approved systems are to be used by approved contractors. Additional specifications will be found in the contract Special Provisions,